Static Pressure Reset Strategy Boosts VAV System Efficiency

The Problem

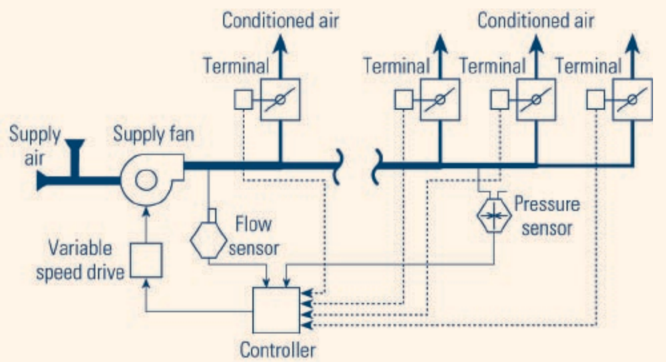
Variable-air-volume (VAV) air handling systems save energy by reducing fan power during partial load conditions. However, most VAV systems (**Figure 1**) squander some of the potential savings because the speed of the supply fan is controlled so as to maintain a constant pressure in the supply duct. This duct pressure is set so that it is high enough to guarantee that there will be sufficient flow of air to the zones being served at full-load conditions. Building systems spend most of their time operating at less than full load due to varying weather conditions and because most air handling systems are designed with more capacity than needed. As a result, duct pressure—and therefore energy use—are almost always higher than necessary when this constant-pressure strategy is employed.

The Solution

A new control strategy called *SAV with InCITe*™ can provide substantial energy savings by optimizing a VAV system's fan speed and airflow. Static pressure adjustment from volume flow SAV increases VAV air handling unit efficiency by reducing duct pressure at part-load conditions. A procedure called InCITe (infer critical information for terminals) optimizes SAV by determining critical supply duct pressure—the lowest duct pressure at which the terminals can remain in control. *SAV with InCITe* has been demonstrated to reduce supply fan energy use in VAV systems by up to 30 percent, with a simple payback period as short as 10 months.

Figure 1: Schematic of a variable-air-volume air handling system

Conventional variable-air-volume systems cut energy use by reducing fan power at part-load conditions, but save less than they could because they maintain a constant supply duct static pressure.



Using *SAV with InCITe* is easy, noninvasive, and relatively inexpensive. InCITe uses a short, simple functional test and a simple model of system behavior to determine the optimal static pressure reset strategy. Once the strategy is developed, a controls engineer programs the new control sequences into the building's energy management system.

Features and Benefits

The optimized strategy provides several important benefits, including reduced energy use, high reliability, and lower noise levels.

Reduced energy consumption and rapid payback. Using airflow measurements and the control sequences determined by InCITe, *SAV with InCITe* is able to reduce energy consumption by adjusting fan speeds to lower the supply static pressure, which reduces supply fan-power requirements. Lower fan power also reduces waste heat and the energy required for cooling. As long as the pressure is kept above the critical pressure determined by InCITe, the airflow will drop only slightly as fan speed decreases because the dampers can open wider to maintain flow levels. That means the savings can accrue without a loss in thermal comfort or indoor air quality. As an added benefit, InCITe detects duct leaks. Repairing these leaks can reduce airflow requirements and save additional energy.

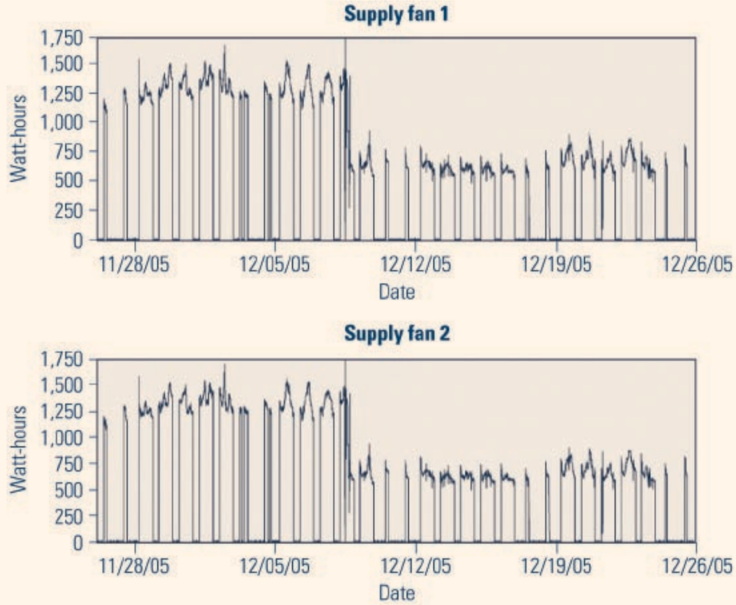
To measure energy savings, evaluators monitored *SAV with InCITe* installations at the Mary Stuart Rogers Building at California State University, Stanislaus, and at the University of California Office of the President building in Oakland. When they extrapolated the data to project annual savings, evaluators found that the system saves an estimated 30 percent of air handling energy use (54,800 kilowatt-hours [kWh]/year) at the CSU, Stanislaus (**Figure 2**) and 20 percent (85,700 kWh/year) at the University of California buildings.

These energy savings translate to annual cost savings of $6,300 for the CSU, Stanislaus and $9,800 for the University of California buildings (at an energy price of $0.115/kWh), giving a simple payback of 0.8 years for the CSU, Stanislaus and 1 year for the University of California buildings. Cost savings and payback periods will vary depending on equipment types, system capacity compared with peak load, and other system variations.

High reliability. *SAV with InCITe* is more reliable than terminal-regulated VAV control strategies because a single terminal unit failure doesn't affect its operation. It also uses less network bandwidth than conventional static pressure reset methods. Using less bandwidth means *SAV with InCITe* is less likely to overload the

Figure 2: Energy savings at the Mary Stuart Rogers Building

Supply fan energy consumption dropped 42 percent following SAV with InCITe installation in December 2005. Lower but still significant savings are expected during warmer months.



control network—overloads can cause data loss for the static pressure control and other processes running on the network.

Reduced mechanical noise. Because *SAV with InCITe* enables lower duct pressure and airflow, there is less hissing from dampers and diffusers and less fan rumble.

Compatible with legacy systems. *SAV with InCITe* works with existing pneumatic and direct digital control (DDC) systems. The system requires that supply fans have DDC controls, but DDC is not necessary for the terminal unit controls. DDC is a microprocessor-based control technology.

Applications

SAV with InCITe can be used in all buildings that have VAV systems, DDCs on the air handlers, and an airflow measuring device. The building's supply and return fans, economizer dampers, and fresh air dampers must be in proper working order.

California Codes and Standards

SAV with InCITe complies with California's Title 24 requirements for static pressure reset (Section 144 [c] 2 B 3 of Title 24). The technology also qualifies for incentives under the University of California, California State University, and Investor-Owned Utility Energy Efficiency Partnership. This partnership is a statewide energy-efficiency program geared toward cost-effective, immediate, and persistent peak energy and demand savings.

What's Next

SAV with InCITe is being used in four buildings at the University of California, Berkeley, and evaluators collected energy-use data in late 2006 and early 2007 before and after the strategy was applied. The data analysis will be included in the final report on *SAV with InCITe* development and testing.

Additionally, developers are working to integrate *SAV with InCITe* into a wireless control system—called FACS—that includes applications for demand response, data center cooling control, and converting constant-air-volume systems to VAV without retrofitting terminals.

Collaborators

Federspiel Controls developed *SAV with InCITe* with support from the California Energy Commission's Public Interest Energy Research Program. The University of California's California Institute for Energy and the Environment is evaluating the *SAV with InCITe* demonstrations in collaboration with Architectural Energy Corp.

For More Information

For more information on this project, please contact the California Energy Commission researcher listed below.

More PIER Technical Briefs can be found at www.energy.ca.gov/research/techbriefs.html.

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About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) Program. PIER supports public interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

Arnold Schwarzenegger, *Governor*

California Energy Commission

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